DOCUMENT RESUME

ED 475 483 SE 067 703

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| AUTHOR | Uzuntiryaki, Esen; Bilgin, Ibrahim; Geban, Omer |
| TITLE | The Effect of Learning Styles on High School Students' Achievement and Attitudes in Chemistry. |
| PUB DATE | 2003-03-23 |
| NOTE | 13p.; Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (Philadelphia, PA, March 23-26, 2003). |
| PUB TYPE | Reports - Research (143) -- Speeches/Meeting Papers (150) |
| EDRS PRICE | EDRS Price MF01 Plus Postage. PC Not Available from EDRS |
| DESCRIPTORS | *Chemistry; *Cognitive Style; Concept Formation; Curriculum Development; *Grade 10; *Grade 9; Learning Strategies; Science Education; Secondary Education; *Student Attitudes |

ABSTRACT

The aim of this study was to investigate the effect of students' learning styles on their chemistry achievement and attitudes toward chemistry as a school subject. One hundred seventy nine 9th grade and 151 10th grade students taking chemistry courses from different high schools were enrolled in the study. The Learning Style Inventory was used to determine students' learning styles. This scale was based on Grasha's criteria and consisted of four clusters obtained from six learning styles. The first cluster consisted of dependent/avoidant/participant/competitive; the second cluster included participant/dependent/collaborative; the third cluster contained collaborative/participant/independent; and the fourth cluster consisted of independent/collaborative/participant learning styles. Also, Attitude Scale Toward Chemistry was administrated to the students to measure their attitudes toward chemistry as a school subject. MANOVA was used for statistical analysis. Results showed that there was a significant effect of learning styles on students' attitudes toward chemistry and their chemistry achievement. Students in learning style clusters 3 and 4 had better understanding of chemistry concepts and more positive attitudes toward chemistry as a school subject. (Author)

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# THE EFFECT OF LEARNING STYLES ON HIGH SCHOOL STUDENTS' ACHIEVEMENT AND ATTITUDES IN CHEMISTRY

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This paper was presented in NARST 2003 Conference in March 23-26, 2003, Philadelphia, PA, USA

SE067703

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Abstract

The aim of the present study was to investigate the effect of students' learning styles on their chemistry achievement and attitudes toward chemistry as a school subject. 179 9$^{th}$ grade and 151 10$^{th}$ grade students taking chemistry course from different high schools were enrolled in the study. Learning Style Inventory was used to determine students' learning styles. This scale was based on Grasha's criteria and consisted of four clusters obtained from six learning styles. First cluster consisted of dependent/avoidant/participant/competitive; second cluster included participant/ dependent/collaborative; third cluster contained collaborative/participant/independent and fourth cluster consisted of independent/collaborative/participant learning styles. Also, Attitude Scale Toward Chemistry was administered to the students to measure their attitudes toward chemistry as a school subject. MANOVA was used for statistical analysis. Results showed that there was a significant effect of learning styles on students' attitudes toward chemistry and their chemistry achievement. Students in learning style cluster 3 and 4 had better understanding of chemistry concepts and more positive attitudes toward chemistry as a school subject.

Keywords: Learning styles, chemistry achievement, attitudes toward chemistry as a school subject.

## Introduction

In recent years there has been an increase in the studies examining individual differences in learning. According to cognitive psychologists, learning occurs by actively processing the new information, thinking and using strategies to build up knowledge (Shuell, 1986). Learning style refers to how people prefer to learn. People have a variety of learning styles; every style is present to the different degrees. While some students may prefer more independent learning styles, others may prefer collaborative styles dominantly. Due to the genetic factors and educational experiences, some learning styles are developed better and preferred more (Grasha and Yangarber-Hicks, 2000). Kolb (1984) claimed that one's learning style depends on heredity factors, life experiences and the environment. So, when dealing with learning styles, physiological, cognitive and affective aspects were considered. The cognitive aspect involves encoding, processing, storing and retrieving information. The physiological aspect involves sensory perceptions, environmental characteristics, times of day for learning and need for food during study. The affective aspect includes emotional and personality characteristics such as motivation, attention, locus of control, interest, persistence, responsibility and sociability (Cornett, 1983). Dunn (1996) stated that one's learning style preference includes the following characteristics: quiet or background noise, bright of low light, formal or causal seating, uninterrupted study or intermittent breaks, perceptual modes, no intake or intake, specific periods during the day, passivity or mobility, global or analytic processing styles. Therefore, learning style inventories used to assess individual's learning style should cover these characteristics. There are different inventories developed by different researchers (Kolb, 1984; Honey and Mumford, 1986, Dunn, Dunn and Price, 1987; Grasha, 1996). The main purpose of the present study was to examine the effect of learning styles on students' chemistry achievement and their attitudes toward chemistry as a school subject.

Research studies revealed that students' learning styles had an influence on their achievement. Cano-Garcia and Hewitt-Hughes (2000) investigated the relationship between learning styles and thinking styles of students and whether these affected academic achievement. 210 college students were administered a learning style inventory and thinking style inventory. They concluded that there was a significant interrelationship between learning and thinking styles. Also, students' academic achievements were affected by their styles. Students with high concrete experience scale had higher academic performance than other students. Mathews (1996) examined how high school students with different learning styles perceived their own academic achievement. It was founded that students with the converger style perceived higher academic performance than other students and students with the diverger style rated lower academic performance than other styles. Collison (2000) also compared learning styles and academic achievement of 110 elementary school students. The results showed that when compared with middle and high achievers, low achievers preferred more formal learning environment. They also preferred to learn with one or more peers compared to high achievers. High achievers favored learning alone. They liked informal learning environment, studying alone, self-direction, and flexibility. They were more self-motivated, persistent, and responsible. Synder (2000) did a similar study for high school students. She concluded that students with high GPA were more self-motivated, persisted and likely to study alone. Another study investigating the relationship between learning styles and achievement was Grasha and Yangarber-Hicks (2000). They additionally interested in types of instruction and examined how teaching and learning styles differed in a technology-dominant and traditional course. The learning styles were classified as dependent, avoidant, participant, collaborative, independent and competitive. It was concluded that students who got A in the traditional courses were less dependent learners. In the technology based course,

the more successful students tended to more abstract in their thinking. In both courses, there was no relation between competitive learning style and achievement.

The differences in learning styles of students also affect their attitudes. Shaw and Marlow (1999) investigated the difference between learning styles, genders and cohorts with respect to attitude toward information and communication technology supported learning. They categorized learning styles as activist, reflector, theorist and pragmatist. Six dimensions for attitude toward information and communication technology supported learning were identified as comfort, interactivity, self-satisfaction, value new technology, experience and context. Results indicated that there was a significant difference between males and females in the theorist scale of learning styles. In addition, there was a significant negative correlation between theorist learning style and interactivity dimension of attitude scale and between theorist learning style and context dimension of attitude scale.

Research has showed that when using strategies associated with students' learning style, greater achievement of students has been observed. Dunn and Giannitti (1990) studied the effects of students' preferences for learning alone or learning with peers on achievement and attitudes. Results indicated that students who preferred learning alone had better academic achievement when they study alone and students who preferred learning with peers performed better in the learning with peers conditions. In addition, students had more positive attitudes when learning conditions were matched with their preferred learning styles.

## Method

### *Problem*

In this study, the effects of 9$^{th}$ and 10$^{th}$ grade students learning styles on their chemistry achievement and their attitudes toward chemistry as a school subject were investigated.

*Subjects of the Study*

179 9th grade and 151 10th grade students from different high schools were enrolled in the study.

*Instruments*

*Learning Style Inventory (LSI)*

Learning Style Inventory developed by Grasha (1996) was administered to all students in the study. This instrument consisted of 60 items in a 5-point likert type. Students were required to rate each item from strongly disagree to strongly agree. Grasha (1996) described six learning styles as competitive, collaborative, avoidant, participant, dependent and independent. These learning styles have the following characteristics:

Competitive: Students compete with other students in the class in order to perform better.

Collaborative: Students learn by sharing their ideas and talents. They enjoy cooperating with teachers and other students.

Avoidant: Students are not enthusiastic about learning. They are uninterested in classroom activities. They do not like attending classes and participating with teachers and other students.

Participant: Students like to attend classes and participate in class activities. They are eager to learn.

Dependent: Students have no intellectual curiosity. They follow the teacher and students as authority.

Independent: Students prefer to work alone on course projects. They are confident in their learning abilities.

The reliabilities (Cronbach's alpha) for each style were found to be 0.79, 0.63, 0.60, 0.65, 0.61 and 0.53 respectively.

The learning styles obtained from the inventory were clustered in four groups according to Grasha (1996) criteria. First cluster consisted of dependent/ avoidant/ participant/ competitive (group 1); second cluster included participant/ dependent / collaborative (group 2); third cluster contained collaborative/ participant/ independent (group 3) and fourth cluster consisted of independent/collaborative/participant (group 4) learning styles.

*Attitude Scale Toward Chemistry (ASTC)*

The previously developed scale ( Geban et al., 1994) was used to measure students attitudes toward science as a school subject. This scale consisted of 15 items in 5 point likert type scale from fully agree to fully disagree.

*Procedure*

Learning Style Inventory and Attitude Scale toward Chemistry were administered to all students in the study. Students' chemistry grades were used as a variable showing their achievement.

## Results

The data obtained from Learning Style Inventory were analyzed by using SPSS (Statistical package for Social Sciences) (Norusis, 1991). According to the data, $9^{th}$ and $10^{th}$ grade students' learning styles distribution was found as follows:

**Table 1.** Students' learning style percentages

| Learning Style | $9^{th}$ Grade (%) | $10^{th}$ Grade (%) |
|---|---|---|
| 1 | 33,5 | 23,2 |
| 2 | 15,6 | 41,1 |
| 3 | 25,7 | 12,6 |
| 4 | 25,1 | 23,2 |

As it is seen on the table, most of the 9th grade students possessed learning style group 1. They held dependent/participant/competitive/avoidant styles. However, most of the 10th grade students possessed learning style group 2. They had a combination of participant / dependent/collaborative learning styles.

It can be said that learning style groups 1 and 2 were more dependent types of learning. In these categories, the learner showed little intellectual curiosity to learn. He followed his teacher as an authority. He learned the context in order to be more successful than other students in the class. He enjoyed classroom activities and sharing his ideas. On the other hand, learning style groups 3 and 4 were more independent types of learning. The learner preferred to work on projects. He wanted to take responsibility in classroom activities. He shared his ideas with his friends. He was confident in his learning abilities. When it was examined the results from this point of view, for 10th grade students, most of the students (64,3%) had more dependent learning styles but 9th graders had more independent styles.

In order to investigate the effect of students' learning styles on their chemistry achievement and attitude toward chemistry, MANOVA was run for 9th and 10th grade students. The results showed that there was a significant mean difference among the students with different learning styles with respect to the collective dependent variables of students' chemistry achievement and their attitudes toward chemistry as a school subject for 9th grade ($F=3.707$; $df=6$; $p<0.05$) and 10th grade students ($F=2.143$; $df=6$; $p<0.05$). Follow-up univariate ANOVA revealed that for 9th grade students there was a significant mean difference among the students with different learning styles in terms of chemistry achievement ($F=5.373$; $df=3$; $p<0.05$) and attitudes toward chemistry ($F=3.287$;$df=3$;$p<0.05$). For 10th grade students, there was a significant mean difference among the students with different learning styles in terms attitudes toward chemistry ($F=2.926$; $df=3$; $p<0.05$). However, there was no significant mean difference among the students with different learning

styles in terms of achievement toward chemistry ($F=2.410;df=3;p>0.05$). Post-Hoc tests showed that for 9th grade students learning style group 4 caused the difference in the achievement and attitudes. For 10th grade students, learning style group 4 caused the difference in attitudes.

Table 2 presents mean scores for students' chemistry grades and their attitudes in terms of their learning styles.

**Table 2.** Mean scores for students' chemistry grades and their attitudes in terms of their learning styles

| Learning Style | 9th Grade | | 10th Grade | |
|---|---|---|---|---|
| | $\bar{X}$ (achievement) | $\bar{X}$ (Attitude) | $\bar{X}$ (achievement) | $\bar{X}$ (Attitude) |
| 1 | 2,76 | 51,15 | 2,55 | 49,51 |
| 2 | 3,00 | 52,75 | 2,51 | 51,20 |
| 3 | 2,74 | 54,84 | 2,74 | 53,26 |
| 4 | 3,66 | 56,33 | 3,17 | 55,69 |

## Discussion

The main purpose of this study was to examine the effect of students' learning styles on their chemistry achievement and attitudes toward chemsitry as a school subject.

The findings of the study indicated that learning style has an influence on students' achievement and attitudes. Students having independent learning style have better chemistry achievement and attitude toward chemistry as a school subject. Students in this style are confident in their learning abilities. They prefer to study alone on a project, term paper or classroom presentations. The teacher acts as a facilitator and helps when needed. The results of this study confirm the results of other research studies that examined the effect of learning

style on academic performance and attitude (Grasha and Yangarber-Hicks,2000; Matthews, 1996; Shaw and Marlow, 1999).

Learning style plays an essential role in teaching and learning. Better acquisition of concepts is obtained when students learn in environments matching with their learning styles., Determination of learning styles alones is not enough to enhance instruction. Teaching style is also important. Research studies claimed that teaching and learning styles are dependent on each other. Teachers' and students' behaviors in classroom are like a dance; in a dance not only one controls the movements, the partners make necessary adjustments and accommodate each other. Similarly in a classroom both teachers and students are responsible for creating appropriate learning environment (Grasha and Yangarber-Hicks,2000). For this reason, integrated model of teaching and learning style should be developed. Educators should identify students' learning styles and design strategies based on students' learning styles to improve learning. There is no one strategy that is effective for all students in a class. Students should experience different methods and then prefer the method that is most suitable for their learning styles (Dunn, 1996). For example, for independent learners who like to study alone, teachers may use case studies, cognitive maps, panels, self-discovery activities, small group workteams, student teacher methods or role playing. For dependent learners who prefer to study with peers and views the teacher as a source of knowledge, teachers may use lectures, teacher-centered discussions, tutorials or role modeling (Grasha, 1996). Knowledge about different learning styles help teachers be aware of limitations in students' learning styles that affect their success. Also, teachers should know about their own learning styles since their teaching styles are based on their learning styles. In this way, they can analyze their teaching styles and easily adapt them to students' learning styles (Cornett, 1983).

School curriculum should be organized based on teaching and learning styles so that each style can be successful in class. Moreover, this allows students to hold more positive attitudes.

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